GAS JOURNAL

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SPECTRE

FOR many years prior to the last war it was customary for the chairmen of gas undertakings, throughout the country, to receive a brief from the National Gas Council suggesting that they should include in their speeches to shareholders a telling reference to the shackles which fettered the gas industry's progress. During those years we asked from time to time in these columns what exactly these shackles were. We discussed the matter in high places without discovering any definition of what they were. We were told the gas industry was striving to progress in an atmosphere of antiquated legislation and that only by some major operation could the coils which held the industry in thrall be cut. The hopes of the industry in this regard have been realized. In January of this year, through the Gas Bill, now an Act, the Government of the day saw fit, in one fell swoop, to dispense with antiquated legislation.

At the present moment millions of pounds are being spent on reconstruction schemes to enable the more extensive supply of gas. These schemes, for some reason or other, and perhaps for no real reason at all, are being shrouded in mystery. Is it that the mantle of that erudite body the Ministry of Information has fallen, slightly larger though unmistakably more moth-eaten, on those who are going to rule the gas industry in the interests of the gas consumer? We detect a pervading element of fear among gas industry personnel which was not exhibited by the pioneers of the industry. We believe that unless people within the industry are sufficiently individual to risk saying something uncensored, bureaucracy will dig its poisonous claws into the industry's scientific and technical development—a development which owes no debt and no origin to Whitehall. Any such insidious piercing of moral fibre will obviously be to the serious disadvantage of the public, and incidentally of the meek within the gas industry whose aim appears to be to toe a wavering line. Amusing capers.

THE CATERING FIELD

THE gas industry is singularly fortunate in its appliance manufacturers. Their aim has always been the production of high quality apparatus, they have expended great effort to improve efficiencies, and they have taken suggestions kindly. This business of giving due consideration to proferred suggestions is a ticklish one, but it can be said that the co-operation and understanding which exist between appliance manufacturers and gas undertakings' research and sales staffs are of the happiest. Let us for a moment take a look at the steadily growing catering load. The Hotel and Catering Exhibition last January showed gas to be in the forefront in appliance design and quality, but at the same time there was little evidence of major improvements and new developments. True, saleable and reliable appliances have been produced and have achieved no little success. Construction is robust, finishes are of a very high standard, and governors and thermostats have been widely adopted. Yet, maybe, there are points, some of them elementary, which might to possible advantage be examined.

"GAS SERVICE" recently published a series of three articles by one of much experience in this particular field. The series in question set out to indicate where and how improvements might be effected. It terminated in the August issue, and has created interest. It is gratifying that manufacturers have taken our criticism in good part. Perhaps they will act on some of the suggestions put forward. The first instalment dealt with cooking ranges and appealed for construction to be on the unit principle to enable central ranges, wall type ranges, and super-imposed ovens to be erected.

Both internally heated ovens with swing doors and semi-externally heated ovens with drop-down doors were advocated, with oven control taps mounted on the front frame, with heat-resisting heads, preferably adjacent to the thermostat; also ignition of the flash tube principle. Burners, it was suggested, should be of lightweight metal, of enamelled finish, and constructed on the non-firing-back principle. As fixed injectors are essential to this type of appliance, pressure governors should become an integral part and be suitably housed. The article contained a criticism of the present kitchen terminology and offered suggestions in this regard. The second article dealt with ancillary equipment and put forward a mass of minor criticisms.

The final article was concerned with counter and still room café sets and emphasized the fact that although most of this type of equipment reaches a high degree of efficiency, some appliances at present appearing on the market fall short of the desired quality. A useful step would be for the equipment manufacturers to co-operate more fully with the catering industry and the gas industry to ensure that appliances are of a standard acceptable to all concerned. In this article again many pertinent suggestions were made, all of a practical nature. The recommendations were advanced only in light of experience, and we feel that they merit study. Superior finishes are important, streamlining is an asset to appearance and, if it is done correctly, to cleaning, thermostatic control is in most cases desirable. Attention is being given to these aspects. The aim of the series, however, was to put forward other fundamental suggestions which involve modification of design, in the hope of strengthening liaison between maker and user and strengthening, too, the lead already held by gas in the catering field.

FUEL AND CHEMICALS

THE belief has been widely expressed in the last few years that coal should be the raw material for an organic chemical industry. Little or no practical progress appears to have been made in this direction even though the chemical research work that has been done enables us to transform in the laboratory substances occurring in coal gas into more complex organic chemicals which (when derived from other sources) have commercial uses. Dr.

Booth, for example in a paper to the Institution of Gas Engineers, has described a great many transformations of this nature and has shown that some of them when carried out in America produce large quantities, even up to hundreds of thousands of tons, of chemicals annually. Why, it is asked, cannot we do the same here?

The answer lies quite simply in the field of economics. Methane, carbon monoxide, hydrogen, and ethylene are the primary starting points which we could secure from our own raw materials. Carbon monoxide and hydrogen can be obtained from producer gas and may serve the basis for chemical processes. Economics, however, dictates that on account of the high cost of coal in Britain only products that command a high price can be made from these gases; such products are likely to be required in comparatively small quantities. When we consider the constituents of coal gas the position becomes more difficult still. Dr. Levinstein has lately computed that the value of 1,000 cu.ft. of methane in the form of base load town gas at the works is between 30d. and 40d. By contrast, methane in the U.S.A. is worth 0.7 cents. Moreover, in the U.S.A. methane can be obtained from natural gas without further purification, whereas expensive processes of liquefaction would have to be applied to coke oven gases in this country. It hardly seems likely that any organic chemical industry can be based on coal gas in this country, except in respect of such constituents as tar, benzole, and ethylene, which can be recovered without considerable cost.

It is probable that as organic chemistry is still in its infancy, some of the more select processes of nature will one day be the basis of industrial exploitation though possibly by other routes. The reduction of carbon dioxide or its condensation to other more reactive substances has not yet been done unequivocally in the laboratory. Professor E. C. C. Bailey many years ago experimented on the conversion of carbon dioxide to formaldehyde and sugars. Although the problem was at that time of theoretical interest only it seems to have high technical importance. Dr. Levinstein, in an address to the Society of Chemical Industry, has regarded this problem as demanding immediate attention. "In another generation or less it may be a vital matter," he says. "It is a problem surely to be tackled now with adequate means in the laboratory. Were the problems solved, to no country would the use of carbon dioxide be so important as for us. We have no oil, little land, a large industrialized population, and only very dear coal. . . . It is impossible to believe that this substance around us in profusion, so easily reduced in the plant, cannot yield something directly to chemistry without the intermediary of the plant or the lag of time. . . . We can but look on coal or oil as a temporary convenience; one that bridges the interval between the present youth of the organic chemistry industry and the maturity that lies before us."

The oil industry is supreme in the production of chemicals from hydrocarbons, largely because the outlets for natural gas and cracking gas are sufficient to take anything like the total quantity available; only through the availability of a real waste product could the production of carbon black be economic. In England a certain amount of carbon black is produced as a by-product of gas manufacture, but methane could not be burnt for that purpose.

Nevertheless, in one way or another there are considerable advances being made in the production of chemicals from coal and oil in this country. We noticed an account in a Durham local paper a few weeks ago pointing out that the I.C.I. factory of Billingham is being connected by a tunnel under the Tees with its new plant at Wilton which will cost some £17 mill. and employ about 10,000 people. At Aycliffe a new £2,000,000 bakelite company will make vynal plastics and also plastic powders, giving employment to another 1,000 people. Kleeman, Ltd., of Aycliffe, also makers of plastic products, already employ 1,000 people. Aycliffe Textiles, Ltd., are making rayon and nylon weaving and creping. De la Rue Insulation, Ltd., are manufacturing laminated plastic boards for railway wagons and other purposes, and it is understood also that the Consett Iron Company are making great progress in utilizing coal derivatives at their steel works and have in hand a scheme to co-ordinate the production of plastics from the waste gases of 19 blast furnaces. The oil industry all over the country is preparing to refine something like 20 mill. tons of oil a year, and it cannot be doubted that a great deal of chemical production will be undertaken in the course of this project. Manchester Oil Refineries, a comparatively small company in the field of oil, are already going ahead through Petrocarbon, Ltd., and Petrochemical, Ltd., for the production of chemicals of every sort, and the eminent organic chemist, Sir Robert Robinson, President of the Royal Society, will join the Boards of these two companies when financial proposals running into millions of pounds have been implemented.

There is much that is being undertaken in the field of chemical production from oil and from derivatives produced from coal by carbonization. Great factories are being built and capital to the extent of many millions of pounds is being spent. It is impossible to give a complete appraisement as to how far this work has progressed or what plans are made, because so little has been published. We believe, however, that useful purpose would be served if a complete account could be published of what is being done in the production of organic chemicals in this country. The possibilities of organic chemistry, as we have hinted, are as yet only scratched, and it would seem logical for a "general staff" to be appointed who would be advised of what is being done, who would be sufficiently skilled to know what could be done, and whose function it would be to give advice on future developments and even to take some hand in initiating those developments. It is necessary that the fullest possible use should be made of all the raw materials that we possess in this country. In that, the gas and coke oven industries could play an important part.

"MORE THAN A BEVERAGE"

In Lower Regent Street stands the attractive corner building known as the Tea Centre, opened in 1946 by the Empire Tea Bureau for the glorification and increased popularity of that beverage The importance attached to tea (it is described as a world-wide social custom, an inspiration to art and design, and a stimulating factor in industry) must be astonishing to the overseas visitor and not a little surprising even to the tea-saturated Britisher. It may be that this concentrated devotion to the interests of the tea-producing industry has blinded the gas industry to the significance of the Tea Centre as a publicity medium for gas appliances. At all events our industry appears to have paid little attention to the Centre's activities, and we propose, therefore, to outline its purpose and undoubted contribution to improved catering. In the first place it must be understood that the Tea Centre, forming as it does a link between the public and the tea producers of the Empire, is designed purely to popularize tea-drinking and encourage the best methods of tea preparation; on all other matters, including the suitability of gas or electrical equipment, it is entirely impartial. The Tea Advisory Department has four sub-sections dealing with industrial catering requirements, caterers' problems, tea services for travellers, and the Services. Each of these sub-sections has a specialized staff prepared to investigate present conditions, and advise on methods of improvement, including, if necessary, the preparation of building plans, staff schedules, and estimated budgets; in the industrial section alone, nearly 4,000 firms have benefited from this service. During the war the Training Department carried out a successful experiment in training canteen supervisors at the Vickers-Armstrong factory at Castle Bromwich. Selected third-year students from domestic science colleges were given a year's practical experience in every department of the canteen. So effective was the scheme that to-day the Tea Bureau has enlarged its scope so as to become one of the foremost training sources in the country. The design of industrial canteen and other kitchens is in the hands of the Planning Department, which recently issued

an excellent portfolio of canteen kitchen perspectives. The production of publications of many types is one of the Bureau's principal duties, and it can be claimed with confidence that its books, leaflets, and brochures are among the finest of their kind. In this connexion, it is interesting to learn that a new book on catering equipment is in course of preparation by the Bureau and will be published by the British Gas Council.

Exhibitions are a regular feature at the Tea Centre (it will be remembered that the "New Homes for Old" show was held there), and a semi-permanent display of catering equipment, organized by the Bureau with the co-operation of the Catering Equipment Manufacturers' Association, is in the basement. The study of tea-making and other catering appliances is the constant pursuit of the Equipment Department, which advises both manufacturers and caterers, co-operating with the former in producing a number of new types of equipment. In the delightful tea bar, a different piece of equipment is in operation every month or so, giving a unique opportunity to observe the behaviour of appliances under actual working conditions; at the moment a café fountain set by Wm. Still & Sons, Ltd., is occupying the limelight. It will thus be seen that the Tea Centre is not so detached from the gas industry as might be imagined; on the contrary, a great measure of co-operation is possible and is, in fact, extremely desirable. We suggest that many in the industry whose work brings them into contact with the catering field would be well advised to pay the Tea Centre a visit; and not only engineers and salesmen—our industry's display artists, too, would be well rewarded, for the Tea Centre and its displays are among the finest examples of modern design in this country. As a last incentive—the tea is excellent.

Letter to the Editor

Compensation Regulations

DEAR SIR,—Many executives in the gas industry who are awaiting with some interest and even anxiety the issue of the regulations governing compensation, &c., may be interested to note that the compensation regulations for the transport industry have been published as Statutory Instrument, 1948, No. 1700, the regulations being referred to as the "Transferred Undertakings (Compensation to Employees) Regulations, 1948."

While there is no guarantee that similar regulations will cover the fuel industries it would be reasonable to suppose that there will be no very material departure from the general plan that has already been laid down for the transport industries. This document may be obtained from H.M. Stationery Office, price 3d., plus postage, and I feel that it will be of general interest to those engaged in the gas industry.

Yours faithfully,
G. E. FOXWELL,
Secretary,
Gas Engineers' National Guild.

"Thorncliffe,"
Oakfield Road,
Ashtead, Surrey.

Personal

Mr. C. G. GRIMWOOD, Chairman and Managing Director of Sudbury Gas and Coke Company, Suffolk, and Mrs. Grimwood celebrated their golden wedding on Aug. 24. Among the many congratulatory messages they received was one from the staff of the Company.

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The reference in our issue of Aug. 25 to changes in the representation of George Wilson Gas Meters, Ltd., should have stated that Mr. B. H. MOORE has taken the place of the late Mr. A. E. Adams in the South of England, and that Mr. J. L. THOMSON has succeeded Mr. Moore in Scotland.

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Mr. W. B. HARRISON, Engineer and Manager of the Sowerby Bridge Gas Department, has been appointed Engineer and Manager of the Middleton Gas Department in place of Mr. H. D. ROBINSON, who will leave Middleton on Oct. 1 to take up the position of Engineer and General Manager of the Burnley Gas Department.

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The Controller of Research of the Gas Light and Coke Company, Dr. H. HOLLINGS, and the Commercial Manager, Mr. S. G. ABERDEIN sailed on Sept. 1 for the United States of America, where they will carry out an extensive tour of various undertakings and industries relevant to the gas industry. The trip will take approximately five weeks. They are accompanied by Mr. A. F. HETHERINGTON, Joint Divisional Manager of the Company's Eastern Division.

Mr. H. V. POTTER, Managing Director, has been elected Chairman of Bakelite, Ltd., in succession to Sir JAMES SWINBURNE, who still remains a member of the Board.

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Mr. WILLIAM CASH, Junr, has been appointed to fill the vacancy on the Board of the Bournemouth Gas and Water Company created by the death of Mr. P. G. G. MOON. Mr. Cash retains his office as Secretary of the Company.

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The following changes have taken place at the Oriental Gas Company: Mr. W. E. GLADSTONE, General Manager, Calcutta, has retired to South Africa; Mr. F. H. ATKINSON, F.C.W.A., F.I.C.A., F.C.I., Joint Acting General Manager, has resigned and is taking up an appointment as Business Manager with Messrs. Kumardhubi Engineering Works, Ltd.; Mr. D. LOGAN EDWARDS, Manager of the Bengal Jute Mill, Ltd., has been appointed General Manager of the Oriental Gas Company.

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The travels of Miss MILLICENT STOBE, of Milngavie, Scotland, a mobile cinema projectionist, displaying films for the British Gas Council, have ended in wedding bells. About a year ago she visited the Mablethorpe Gas Company to give a display, and met Mr. FRANK BEAUMONT, the Engineer and Manager, whom she married on Aug. 27. Mrs. Beaumont was on the staff of Ace Distributors. In two tours she travelled over 3,000 miles, gave 800 shows at 100 gas undertaking to audiences totalling 100,000. In the course of these tours "The Manufacture of Gas" was shown 767 times. So familiar has Mrs. Beaumont become with the commentary of this film that she can recite it from memory. Although the gas industry has claimed her, the Mobile Film Scheme will not suffer. Her sister, Miss Jean Stobe, has taken over her job on a new tour which commenced on Aug. 31.

Diary

Sept. 13.—**London and Counties Coke Association**: Technical Committee, Gas Industry House, 2.30 p.m.

Sept. 13-17.—**Association of Public Lighting Engineers**: Annual Conference, Winter Gardens, Devonshire Park, Eastbourne.

Sept. 14.—**Industrial Gas Development Committee,** at British Coal Utilization Research Association, Leatherhead, 10 a.m.

Sept. 14.—**British Gas Council**: Central Board, Gas Industry House, 2.30 p.m.

Sept. 14.—**Federation of Gas Employers**: Central Committee, Gas Industry House.

Sept. 14.—**Gas Salesman's Circle (Scottish Western)**: "Night and Day," R. J. Gregg, Sales Manager, Ascot Gas Water Heaters, Ltd., 137, Sauchiehall Street, Glasgow, 5 p.m.

Sept. 14.—**National Federation of Gas Coke Associations**: General Committee, Gas Industry House, 10 a.m.

Sept. 14-15.—**Irish Association of Gas Managers**: Annual Meeting Cork.

Sept. 15.—**Eastern Junior Gas Association**: Opening Meeting. Presidential Address, H. J. Patching, Peterborough. Ladies invited.

Sept. 15.—**B.G.C. Domestic Development Committee**: Technical Sub-Committee, 10.30 a.m.; Main Committee, 2 p.m. Gas Industry House.

Sept. 20.—**London and Counties Coke Association**: Gas Industry House, Finance Committee, 11 a.m.; Executive Committee, 11.30 a.m.; Central Committee, 1.30 p.m.

Sept. 22-23.—**Wales and Monmouthshire Association of Gas Engineers and Managers**: Newport. Sept. 22, golf competition, bowling competition. Sept. 23, Meeting, Assembly Room, Town Hall, Civic welcome. "Specifications, Planning, Laying, and Testing of Gas Mains with particular reference to High Pressire Mains," E. M. Edwards, M.Inst.Gas E., A.M.I.Mech.E., Engineer and Manager, Port Talbot Gas Department; "Some Thoughts on Promotional Tariffs for the Small Undertaking," K. E. Tiddy, M.Inst.Gas E., Engineer and Manager, Carmarthen Gas Company. Official luncheon, 1 p.m. Tour of Pontypool Gas-works, 2.15 p.m.

Sept. 22-23.—**Institute of Statutory Inspectors of Gas Meters**: Annual Conference, Edinburgh, preceded by a Civic Reception.

Sept. 24.—**Institute of Fuel (Scottish Section)**: Annual General Meeting followed by D. M. Yuill, of Messrs. Wolsey, Ltd., on "Heat Conservation in a Dyeing and Finishing Works," 39, Elmbank Crescent, Glasgow, 6 p.m.

Sept. 27.—**Women's Gas Council**: Executive Committee, Gas Industry House, 1 p.m.

Sept. 29.—**Institution of Heating and Ventilating Engineers**: "Research for the Heating, Ventilating and Air Conditioning Engineer," Cyril Tasker, M.I.H.V.E., Director of Research, American Society of Heating and Ventilating Engineers, at the Institution of Mechanical Engineers, Storey's Gate, S.W.1, 6 p.m.

News in Brief

A Report on the working of Darlington Gas Department states that the general reserve fund amounts to £1,688.

The Grey Edition of GRB 21/11, "Catalytic Synthesis of Methane," is now available from the Gas Research Board, 1, Grosvenor Place, London, S.W.1.

Scotland's Biggest trade exhibition is to be held in the Kelvin Hall, Glasgow, next year. It will be called the Scottish Industries Fair and run by the Scottish Council (Development and Industry) on similar lines to the B.I.F. A £100,000 guarantee fund is to be launched soon.

The Annual Fruit Bottling Week, held by the Darwen Gas Department in conjunction with the Ministry of Food, in the Darwen gas showrooms, from Aug. 16 to 20, was as popular as ever. There were two demonstrations daily to large audiences numbering over 600, and many who were unable to gain admittance crowded round the showroom window.

The Second Edition of "Cook with Ease," by Olive L. Humphries, Home Service Organizer to the Birmingham Gas Department, has been published by Cornish Brothers, Ltd., 39, New Street, Birmingham, price 8s. 6d. net. The book comprises a great variety of recipes and dishes, all of which have been listed, and includes notes on gas cookery and laundry work.

"The Nation's Wealth" is the title of an exhibition which is planned to open at Gas Industry House shortly. It will show the history of the gas industry and modern gas production, including the many uses to which gas by-products are put in industry and commerce. It is being arranged by the Exhibitions Department of the British Gas Council.

An Eight-year Old Boy, of Chatham, Kent, won the "Pictures in the Fire" essay competition run by the British Gas Council. The prize is one-week's holiday for him and his family at Butlin's Holiday Village, Mosney-on-Sea, nr. Dublin, with free air travel to and from the village. Competitors were asked to write a 200-word essay on "What Mr. Therm Gets Out of Coal."

The Trade Statistics for June, 1948, just issued by the Department of Industry and Commerce in Eire, show imports of 30,719 tons of gas coal, valued at £131,954, as against 23,492 tons, valued at £105,793 in June, 1947. This brings the total of these imports for the first six months of 1948 to 136,361 tons valued at £593,634 compared with 54,938 tons, valued at £201,403 in the corresponding period of 1947.

Buxton Wells Dressing Festival has again been celebtrated at Buxton. The event dates back to the Romans, who offered grateful thanks for the curative waters obtained from the famous wells. Judging from the interest taken in Ascot gas water heaters and other gas appliances which were displayed during the festival the present generation is no less grateful for the blessing of instantaneous hot water.

The Alliance and Dublin Consumers' Gas Company had an attractive stand in the Industries Section of the Royal Dublin Society's Horse Show, at which the New World No. 1430 Cooker was featured. Also displayed were many heavy duty appliances, including Richmond's "Chester" Double Duty oven range, the Stott "Hotcupboard" and Richmond's "Causeway" fish fryer suitable for cafés and small hotels.

Stockton Gas Department made a loss of £9,630 for the year ended Mar. 31. Total income was £409,194 and working expenses £405,935, leaving a gross profit of £3,259. Other charges included £5,855 interest on loans and £7,034 redemption of loans, bringing about a loss of £9,630. After taking into consideration £13,985 brought forward, there was £4,355 to be carried forward to this year's account. The reserve fund amounted to £9,213.

The British Limbless Ex-Servicemen's Association is appealing for greater public support. Many of the 45,000 veterans of the 1914-18 war overcame the handicaps imposed by amputation and the majority are leading full and useful lives to-day. B.L.E.S.M.A. was able to help them. In the 1939-45 war a further 10,000 men suffered loss of limbs and many are now in urgent need of assistance. The address of the Association is: 25, Charles Street, London, W.1.

The Board of Trade, in consultation with the Central Price Regulation Committee, has made the Miscellaneous Goods (Maximum Prices) (Amendment No. 2) Order, 1948, operative from Aug. 17. This Order makes minor amendments to the Miscellaneous Goods (Maximum Prices) (Amendment) Order, 1948; S.I. 1948, No. 776. It varies the scope of that Order by including hard haberdashery and excluding thermal storage water heaters and certain types of wireless sets; and it alters the definition of excluded iron and steel articles in the Second Schedule.

The British Standards Institution has published B.S. 1458/9 which includes two specifications for alloy steel castings for structural and general engineering purposes. For each specification test values for the tensile, impact and hardness test are stipulated. The chemical composition is not specified except for the sulphur and phosphorous content, but recommended heat treatment procedures are given.

Members of the Burnley branch of the Women's Gas Council, numbering 104, visited the Oswald Street Gas-Works on Aug. 17. They were received by Mrs. Ames, President of the branch, and by Mr. A. F. Ames, Engineer and Manager, and conducted by members of the technical staff round the works, the processes of gas manufacture and purification being fully explained. After the tour of the works the party were entertained to tea in the works mess room.

Mr. J. H. Morrison, Bolton Lighting Superintendent, has reported to the Corporation Lighting Committee that during the period of the summer shut down, from May 24 to July 26, over 600 panes of glass in gas lamps throughout the town were broken. Hopes for an improvement in behaviour in this respect following the end of the war had not materialized. Past experience had shown that when the help of head teachers of schools has been sought, there has been less damage, at least for a time.

Simon-Carves, Ltd., are to build a £1¼ mill. coal-cleaning and carbonizing plant at Vryheid Coronation Colliery in the Transvaal for the Anglo-American Corporation of South Africa, Ltd. Coal will be cleaned at the rate of 175 tons per hour in a Simon-Carves Baum type washery and will be carbonized in 184 Simon-Carves Underjet ovens of the waste heat type with a coking capacity of 1,600 tons of coal per day. The coke ovens will be in two batteries of 92 ovens each.

A New Coke-grading Plant was opened at Gainsborough on Saturday by Mr. E. W. Wood, Chairman of the Department. He commented that he did not think Gainsborough would fare so well under nationalization. There had been a pride of ownership and administration during the 50 years that the undertaking had been in the hands of the Council. The new plant, costing £7,000, had been installed despite nationalization because the Committee thought it would be beneficial to the commercial and domestic consumers of coke.

The Liverpool Gas Company pays considerable attention to the education of its staff, and in this connexion, it is interesting to note that seven members of the staff have been successful in the recent examinations of the Institute of Costs and Works Accountants. Six passes were recorded in the intermediate examination and one in the final examination. Mr. J. E. Powers, Office Comptroller of the Liverpool Gas Company, is Chairman of the local branch of the Institute of Costs and Works Accountants.

FUEL AND POWER OUTPUT UP

Figures issued by the London and Cambridge Economic Service in its Index of Industrial Production show that output in the fuel and power industries is steadily rising and that industrial output generally is near its peak.

An extract from the index for industries with gas industry connections is given here :—

Average 1946 = 100.

Period	Total Index	Industrial Machinery and Equipment	Chemical and Allied Trades	Fuel and Power
Av. 1935 ..	99	74	76	86
Av. 1946 ..	100	100	100	100
Av. 1947 ..	108	123	100	103
1948.				
Jan. ..	117	142	113	117
Feb.	123	158	118	117
Mar.	115	140	113	109
Apr.	122	148	118	113
May	115	138	112	105
June	122	—	—	109

This is a revised version of the index, new data having become available since the index was last issued. It shows that the post-war peak of industrial production was in February last. Previously the peak was considered to have been in November, 1947, but the figure for that month has now been revised to 122. The index for June (a provisional one) is the same as for November and April last.

WALES AND MON. ASSOCIATION

The Annual General Meeting of the Wales and Monmouthshire Association of Gas Engineers and Managers opens at Newport, Mon, on Sept. 22, with a golf competition at Newport Golf Club, Rogerstone, and a bowls match at the Lysaght Institute, Newport.

Sept. 23 is the day for business, with the meeting taking place in the Assembly Room at the Town Hall, where the Deputy Mayor, Alderman W. F. E. Smith, J.P., will give a civic welcome to the delegates. The official luncheon will be held at the Westgate Hotel and in the afternoon there will be a tour of inspection of the new plant which is being constructed at the Pontypool Gas and Water Company's Works.

Papers to be presented to the meeting are " Specifications, Planning, Laying, and Testing of Gas Mains, with particular reference to High Pressure Mains," by E. M. Edwards, M.Inst.Gas E., A.M.I.Mech.E., Engineer and Manager, Port Talbot Gas Department, and "Some Thoughts on Promotional Tariffs for the Small Undertaking," by K. E. Tiddy, M.Inst.Gas E., Engineer and Manager, Carmarthen Gas Company.

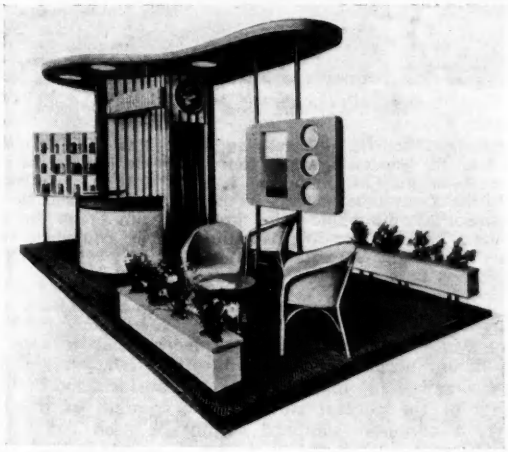
The golf competition is an 18-holes bogey contest for the Dean Cup, followed in the afternoon by an 18-holes friendly four-ball match.

WISBECH LIGHTING COMPANY

So satisfactory was the working of the Company during the past half-year that at the half-yearly meeting it was decided to increase the dividends by 1% to make up for reductions in the past. The Company created a record by producing well over 100 mill. cu.ft. of gas during the half year. The Directors' report disclosed a net profit for the half year of £6,717, which made the amount to be disposed of £9,477. The following dividends were recommended: On Preference shares, 6%; on Ordinary stock (£3 certificates), 13%; on Ordinary £5 shares, 12%. This left a balance of £7,936. The Chairman (Mr. G. S. Gardiner) said the demand for gas continued to grow and its use had become a habit. To meet the continually increasing demand it had become necessary to extend the plant, and progress with these works was being made though labour shortage had caused some delay. Costs had gone up considerably and the manufacture of gas was higher by £3,484, of which coal accounted for £2,611. Total expenditure increased by £4,793. Expenditure, however, was more than fully met by receipts, the sale of gas realizing £2,700 more than in the corresponding half of 1947, due partly to increased price.

PORTABLE STAND AT FLOWER SHOW

Shown below is the ultra-modern stand employed by the Tottenham and District Gas Company at various flower shows in the Company's area as a focal point for home service enquiries and, in particular, instruction on fruit bottling. Occupying a floor space of 20 ft. by 10 ft., the stand is designed for ease of carting and speedy erection, being highly sectional and, with the exception of the cornice holding the floor sections together, secured by wing nuts and bolts throughout. Simplicity in erection is proved by the fact that four men can put up the stand in less than three hours, including any touching up of



paintwork, &c. Variations in floor level, which are bound to occur when erecting on grass, can be taken up by the screwed flanges on the supporting columns. The circular centre is hollow and forms a storage place for literature, hats, coats, &c. As the stand is frequently situated close to large masses of flowers, a light effect is essential and this has been achieved by the liberal use of natural oak wallpaper and scarlet supporting columns; the roof is peach colour underneath, edged with silver.

STOKERS' BREACH OF CONTRACT

Two former stokers employed by the Shifnal (Shropshire) Gas Company pleaded not guilty at the local magistrates' court on Sept. 3 to charges, under Section 4 of the Conspiracy and Protection of Property Act, 1875, that they broke their contracts of service with the Company, knowing, or having cause to believe, that the consequences would be to deprive the inhabitants of the town of Shifnal of their supply of gas.

The Bench decided that there had been a breach of contract and ordered the men, John O'Regan and William Enoch Williams, each to pay 35s. costs.

Mr. A. N. Gwynne prosecuted for the Company and the men were defended by Mr. C. Vincent Matthews.

Mr. Gwynne said O'Regan was engaged in March this year and Williams in July. The contracts stipulated that each man should for the proper performance of his duties, and during the continuance of his employment, occupy certain dwelling houses. In July they gave notice, and the agreement stated that on the termination of employment the servant should forthwith quit the premises.

Although the men gave notice terminating their contracts of employment neither of them had complied with that clause in the agreement and were still occupying houses which they occupied by virtue of their employment. The Company needed three stokers, but with O'Regan and Williams still occupying the houses the Company had failed to get other stokers to work for them. The Works Manager had had the job of stoking, and the Managing Director was also doing all he could to assist. The position now was that the Ministry had already been warned that there would be no gas supply in the area served by the Company from mid-day on Sept. 11 until Monday morning because the present employees were working at such a rate that there was liable to be a breakdown.

The one remaining stoker was working 18 hours a day and it was imperative that he had time off. If anything happened to any of the men now working then the supply might be affected during the week also.

It was contended, said Mr. Gwynne, that O'Regan and Williams knew that unless they got out of the premises the probable result would be that the supply of gas to the area would be seriously affected.

Mr. Balfour Rowlson, Managing Director, said three stokers was the minimum number required. O'Regan left a few hours before his notice expired. Williams worked out his notice and said he had no intention of getting out of the house.

The Company now had two men they wanted to put in the houses. He added: " We have been on 18 hours a day during the last fortnight and it is impossible to continue. There is no alternative but to cut the supply to give the men a rest."

Answering Mr. Matthews, Mr. Rowlson agreed that proceedings for ejectment were pending in the County Court.

Mr. F. R. Jones, Works Manager, said he had advertised and received 55 applications from stokers, but could not engage the two men they wanted because O'Regan and Williams were still in the houses. He added: " We are in a hopeless position and we shall definitely have to close down at least week-ends and probably in the week. The only remaining stoker is working 18 hours a day and my Chairman and I are working likewise."

O'Regan, in evidence, said he had never heard of the Conspiracy and Protection of Property Act until he received the summons. The contract of service was not read to him and he did not have a chance to read it. He had been paying 6s. weekly rent for the house and had nowhere else to go. The Company had employed another stoker fours days before he left.

Williams also said he had not read the contract, and left on medical advice.

Colonel the Hon. F. H. C. Weld Forester, Chairman, said the Bench thought there had been a breach of contract. He told the men: " We hope you will clear out of the houses. You will be charged with the costs."

On Saturday (Sept. 4) 72 years old Mr. Harry Stephens, a retired labourer, who lives five miles from Shifnal, volunteered to work as a stoker to help. His offer was accepted by Mr. Rowlson, who told a correspondent, " The old man is a real brick, and was determined to help us." A Midland Region Ministry of Fuel official stated they would do everything possible to assist in preventing the threatened breakdown.

INCREASED COAL STOCKS

A slight increase in stocks of coal at gas-works is shown in the Ministry of Fuel and Power's weekly statistical statement over three weeks of August. Stocks for the week ending Aug. 14 stood at 2,172,000 tons, enough for 3.8 winter weeks' consumption. For the week ending Aug. 21, they were 2,189,000 tons (3.9 weeks), and at Aug. 23 were 2,268,000 tons (4.2 weeks). Stocks of coal at gas and electricity undertakings at Aug. 28 were 2,230,400 and 4,078,500 tons respectively. Comparable figures for stocks at electricity undertakings for the same periods were 5.7, 5.7, and 5.2 week's consumption. Total summer consumption of coal to date (16 weeks) by gas-works has been 6,594,000 tons, compared with 5,928,000 tons for the same period of 1947.

X-RAY PROVING OF WELDED STRUCTURES

Most gas engineers will have experience of welding as a method of repairing damaged steelwork, and will be aware of its widespread employment for the fabrication of small steel components. They will also be aware that much of the present-day condensation and wet purification plant takes the form of electrically welded steel vessels, although they may not quite realize the extent to which this type of construction has now found favour in the gas industry. It is now the rule, rather than the exception, for condensers to be of welded steel construction, and an increasing number of ammonia and naphthalene washers are so fabricated. Electro-detarrers have almost always been electrically welded, while a considerable number of both high and low pressure gasholders, and of oxide purifiers, now have welded seams.

MEMBERS of the Institution of Gas Engineers will recall that the condensation and wet purification plant they saw during their recent inspection of the South Metropolitan Gas Company's Rotherhithe Works, and the primary and secondary condensers at the Gas Light & Coke Company's Beckton Works, were of welded steel construction. Often in the past the basic chemical-engineering design of gas-works plant has had limitations imposed by

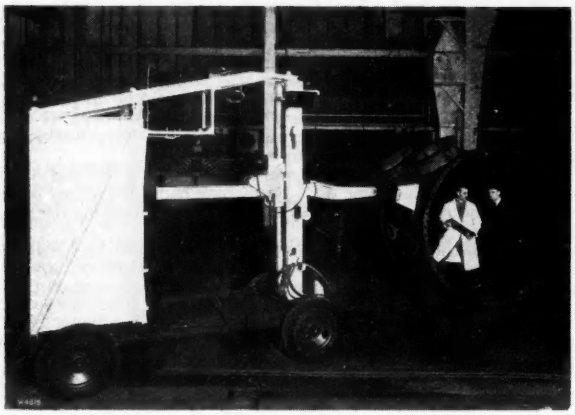


Fig. 1.—Mobile X-Ray Unit.

the materials of construction, but with the flexibility of design resulting from welded steel fabrication, the unit processes can be designed to operate with an inherently higher efficiency than would otherwise be possible. The increasing employment of welded vessels in the gas industry thus makes it essential that means should be available for proving the welded seams, quite apart from the many and stringent precautions which must be taken when fabricating high pressure vessels in accordance with the Lloyds Class I type of welding codes. Radiography provides the logical solution of this problem.

On a recent visit to the works of Whessoe, Ltd., at Darlington, we were impressed by the extent to which the application of X-ray equipment to the examination of welded structures has been adopted by the firm—unquestionably to all-round benefit. Such equipment is costly. The interpretation of its results demands trained staff and a highly skilled technique. This has been fully appreciated by Whessoe; and the following short abstract is based on a paper given by Mr. R. F. Bishop, M.A., a member of the staff, to the Institute of Marine Engineers, and published in the Institute's *Transactions* for June, 1948 (Vol. LX, No. 5).

During the course of his paper the author explained that for the majority of light alloy work and for mild steel under 1¼ in. thick, an X-ray set with a maximum kilovoltage of 140 or 150 is ideal. Such a set is capable of X-raying steel of considerably greater thickness, but if much work of, say, 1¼ in. or thicker is envisaged a set of higher output is advisable. For steel from 1¼ to 2¼ in. thick a 200 kV. set is necessary, while a 400 kV. set will X-ray up to 4 in. and a 1,000 kV. set 8 in.

For work in a welding shop where a reasonable degree of portability is required a mounting such as that shown in Fig. 1 is ideal. The equipment comprises the X-ray tube and high voltage transformer together in one container, the controls, which are all in the operators cubicle, and the oil cooling system with a radiator. The complete equipment is wheeled into position or lifted over any obstructions by the shop overhead cranes. The X-ray head itself may then be raised or lowered by an electric motor or moved in and out horizontally by hand. The column on which it is mounted may be swung nearly 360 deg., the trunnion supporting the head rotated about its own axis and finally the head moved within the trunnion. These adjustments enable the tube to be positioned very rapidly and easily. The cubicle housing the operator is lead lined to protect him from the harmful effects of X-rays during an exposure. It should be emphasized that when X-rays are used, adequate lead protection screens and warning arrangements must be used to protect neighbouring workers. Fig. 2 shows the X-ray darkroom at the Whessoe works.

For site examination of welds in relatively thin plate a light portable set with an output of about 150 kV. is suitable. In order that the weight of any one unit shall not be excessive the components are separated into a number of containers. With a separate tube, transformers, cooling system, and control panel, each individual unit can be manhandled more easily, but the time to set up the equipment is increased. This splitting-up of components usually causes an increase in the overall weight, which is further increased for site work by the greater degree of robustness necessary to allow for careless handling and for weather-proofing.

Where higher outputs are required the size and weight of the equipment is much greater. With these larger-output portable sets one of the greatest sources of difficulty is the flexible high-tension cables, which require careful handling and are very heavy. These higher-powered sets are scarcely portable in the proper sense, their total weight being more than a ton. The parts which must be

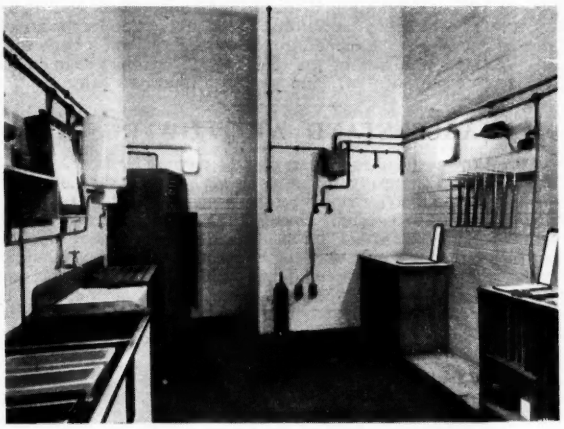


Fig. 2.—The X-Ray dark room at the Whessoe works.

easily handled are the tube itself and the cables. One in position on a site, the generating plant can usually be left in one place.

The American G.E.C. million volt set is of a novel design, having the X-ray tube situated in the centre of a resonance type of transformer, the whole being insulated with Freon gas under pressure. The rays are so penetrating that the equipment has to be housed in a separate building. There are only two of these sets in operation in this country.

Radiographic Acceptance of Welds

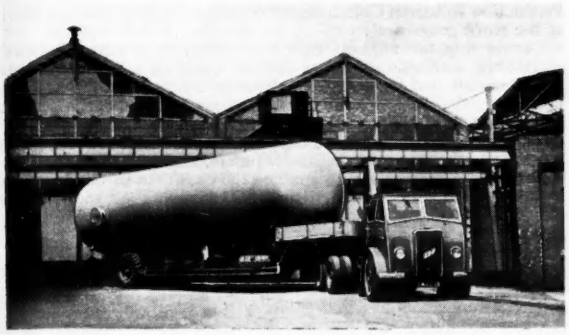
The widespread use of radiography has led to many discussions on acceptance standards. This is a very difficult question embracing many factors the consideration of which belongs to the general study of the strength of materials. Clearly a common standard cannot be used for Class I pressure vessels and for such work as site-welded liquid storage tanks.

The only standards in existence are for high grade pressure vessel welds and are those laid down in America by the A.S.M.E. and A.P.I.-A.S.M.E. codes. According to these codes any weld containing a crack or lack of fusion must be cut out. A weld with slag inclusions is acceptable, provided that the largest inclusion does not exceed 1/3t in length, where that is the thickness of the plates joined, and that the combined length of inclusions in a length of 12t does not exceed that. The porosity allowable is

given by a set of standard radiographs showing "border-line acceptance" and "not acceptable" porosity.

In this country there is no such set of standards and pressure vessels are usually made to some such specification, as Lloyd's Rules for Pressure Vessels, The A.O.T.C. Rules for Fusion Welded Pressure Vessels, Admiralty Class A, or I.C.I.269A. All of these leave the assessment to the inspector, which necessitates his having a very good knowledge of radiography. Lloyd's further specify that only those firms on their list of approved manufacturers may manufacture vessels to their Class I standards. They rely very largely upon the manufacturer after having first subjected his work to a very rigorous set of tests and examined and approved his manufacturing, and general X-ray inspection facilities.

One of the greatest difficulties underlying the fixing of radiographic standards is the lack of any comprehensive body of information concerning the mechanical strength of welded joints with known defects. For this, of course, simple tensile tests are not sufficient. The attempts made in Germany in the 1930's provided valuable but unfortunately incomplete and sometimes contradictory information.*



Shop welded pressure vessel with seams completely X-rayed. Photographed on despatch from the Whessoe Company's Works to form part of a pressure holder installation for the Mid Kent Gaslight Company at West Malling. Three holders of this type, each having a releasable capacity of 30.000 cu. ft., are being built to Lloyds Class 1 Code, design pressure 240 lb. per sq. in. (hydraulic test pressure 480 lb. per sq. in.)

Fatigue tests would be the best single type of test and a great deal of useful work remains to be carried out correlating the results of such tests with X-ray examination of faulty welds.

Up to now high grade work to Class I specification has been considered. When considering the examination of lower-grade welding, a number of additional factors make accurate appraisal more difficult. For work of this class, slag inclusions of a reasonable size may perhaps be permitted but these may mask more vital faults.

X-Ray in Development and Inspection

Radiography may be applied in many spheres. Every foot of the main seams of all pressure vessels built for the most exacting work are X-rayed, but for the bulk of welded construction this expense is difficult to justify and the method would scarcely be an economic possibility. Its effective utilization in such cases must be carefully planned.

First, X-ray examination should be used during the development of the welding procedure and it will give very valuable information about the plate preparation, the gauges of electrode, and such matters as the chipping out of the backs of welds. Further use is divided into two main channels: Training the welders and spot inspection. Each welder's work is examined, first on trial plates and then on a considerable length of seam made as part of an actual job. The examination is continued until it is quite certain that he has both the necessary skill and knowledge and better appreciation of the quality of his work. After the welders have passed this period satisfactorily all welding is subjected to periodic spot checking, the proportion of exposures depending on the results obtained. As long as the standard remains high this proportion may be very small. If a particular welder's work is found faulty, further examination is carried out. The aim for welding other than Class I should be to maintain a high general standard and not to cut out and repair individual small faults. If bad faults are found, then all the seams recently welded by this welder must be examined further or else repaired without further testing. It is illogical just to repair the one fault revealed. Naturally any cracks or lack of fusion would make repair necessary. In general these are most likely to be due to faulty procedure, bad electrodes, or possibly the composition of the steel and further investigation is necessary.

The author concluded by stressing the importance of using X-ray results in the training of all people concerned with welded work. This includes technical members of the works staff, welding foremen, and the welders, caulkers, and platers themselves.

Certainly Whessoe, Ltd., have spent much effort and time to ensuring first-class results from X-ray technique, concurrently raising the standard of welding practice.

ELECTRONIC INSTRUMENTS

A trade exhibition of electronic instruments held recently in London was such an outstanding success that it has been arranged to hold a similar show in Birmingham. A new range of instruments for use in industry and research will be on display at the Grand Hotel, Birmingham, from Sept. 20-24 inclusive. The exhibition will be open from 10 a.m. to 6 p.m. daily. Admission, which is free, will be limited to ticket holders only.

One of the most interesting exhibits will be the industrial electronic metal detector. "Tramp" metal can and does occur in many products and is both an expense and a worry to manufacturers: now for the first time in this country an electronic metal detector is available to detect tramp metal in raw material and in manufactured goods before they leave the factories. Another metal detector on display will be a portable instrument which is now in wide use among gas undertakings. Its applications are to trace buried pipes, to locate lost manhole covers and to test timber to ensure that the wood contains no hidden metal when it is used by the sawmill.

Three new oscilloscopes will be demonstrated; the Laboratory Oscilloscope, a moderately priced instrument suitable for general work; the Demonstration Oscilloscope, specially adapted for lecture work and including a 15-in. cathode ray tube; and the Universal Oscilloscope, an instrument of unit construction which has been designed to cover as wide a variety of applications as possible.

The exhibition is being organized by Cinema-Television, Ltd., London, S.E.26.

THE NATIONALIZED INDUSTRIES

How does the Gas Act compare with earlier laws setting up public corporations? Very well indeed, according to Mr. D. N. Chester, Fellow of Nuffield College, Oxford, who has set out his views in a comparison of pre-1939 as well as more recent measures in *The Nationalized Industries: A Statutory Analysis*, published by the Institute of Public Administration, price 2s. 6d. "The Gas Bill," he writes, "appears to be the best devized of the nationalization measures so far and in some part this must be due to the Minister of Fuel and Power having been able to take account of the criticisms levelled against earlier measures and of the experience of, for example, the National Coal Board."

He instances these differences from the "earlier pattern."—

(i) The Area Boards are given a large measure of independence and are not mere creatures of the Central Board, *e.g.*, each Area Gas Board must aim at balancing its own revenue account, whereas in the case of both electricity and transport, the revenue accounts of the Area Boards and the Executives are merged in the undertaking taken as a whole.

(ii) The Minister must report to each House of Parliament with respect to the exercise of his functions during the year under the Act. No such provision is found in any of the other nationalization Acts except that for electricity.

(iii) The Minister must lay before each House a statement of the remuneration and allowances payable to members of the Area Gas Boards and the Gas Council and also notify each House of any subsequent changes. This also is not to be found in the other nationalization Acts except that for electricity.

The Gas Act, adds Mr. Chester, is also interesting for its statutory recognition of the need for consultation with the Boards of other nationalized industries. Thus, in planning and carrying out any programme of capital development and reorganization of their activities relating to carbonization the National Coal Board, the Gas Council, and the appropriate Area Gas Board are required to consult with each other.

So Mr. Chester thus shows that we are learning a little from experience, and goes on to analyze the set-up of the corporations which have been formed for 11 industries—only three of them pre-war. It appears that there are three obvious differences between the statutory provisions governing the pre-war public corporations and those established since the advent of the Labour Government. These, Mr. Chester says, are a considerable increase in the powers of the Minister to control and interfere in the working of the corporation; the chairman and members of the post-war boards are usually in a less independent statutory position, and that the post-1945 corporations have less financial independence than their predecessors.

The author's analysis covers the constitution of the new undertakings, the Area Boards and executives, the advisory or consumers' councils, ministerial control, finance, accounts and audit, and annual reports. His 48-page work ends with a select bibliography and a list of legislation.

* Muller, A. W. 1938/9 Heft I. S 25/26, Archiv fur das Eisenhuttenwesen, "Der Zusammenhang zwischen dem Rontgenbild einer Schweissnaht und ihrer Zugiestigkeit."

EVALUATION OF RESEARCH

AN AMERICAN POINT OF VIEW

Recently, in a paper at the annual meeting of the Pennsylvania Gas Association, the Research Consultant to the American Gas Association, Mr. N. K. Chaney, discussed the possible return per dollar of A.G.A. research expenditure. The following is an extract from the paper.

THE successful conduct of organized research involves more than the possession of, or the ability to hire, adequate research services. In business a research department is comparable to a "drive it yourself" motor car. Its use requires a driver, a road map, and a destination. To supply these requirements is the ultimate responsibility of business management, and this job can never be delegated. In the case of Association research this function of management in industrial research must be supplied by the research managing committees, and for this reason the policy-making executives of the individual member companies must be adequately represented on these managing committees.

Lower Cost

The relevance of such developments to Association research will be obvious. It used to be a moot question whether any association of independent companies could possibly hope to formulate and execute long-range research programmes with the efficiency and continuity so successfully displayed by major corporations having the advantages of centralized direction and control. The advent of research as a purchasable commodity has greatly eased the association's problems by eliminating the necessity for acquiring the special know-how and experience required to staff and organize a research department. There are also important compensating advantages for association research as compared with private research. A major advantage is the lower cost of research per association member. Administration costs of research are always high and perfection is never achieved in the best of companies.

Assuming, for example, that the overhead costs of research administration are 100% of the direct research work, this would mean that an independent company would get 50 cents worth of actual research effort for each research dollar spent. Compare this with one of 10 association members each of whom pays one-tenth of the total research budget dollar or a cost of 10 cents. Each such member gets all the benefits of 50 cents cost of actual research effort with two exceptions : (1) no member company can thus obtain a patent monopoly which will enable him to deny the benefits of the research to his fellow members, and (2) no member can collect royalties from the other for using the new processes. Patent monopolies offer the private industrial company the possibility of either improved competitive advantages over rival companies or of large profits through royalties —thus the inducement to take higher risk. No such competitive advantage accrues to a utility and none is needed.

Hence, assuming reasonable efficiency, collective or association research promises the average "non-competitive" utility the greatest possible return per dollar of research expenditure.

The American Gas Association possesses important advantages compared with many associations for the wise planning and efficient conduct of collective research for the industry.

First, between the gas utility members of the Association there is a highly unusual degree of freedom in the interchange of technical and operating experience. Second, the amount of time and effort which is freely devoted to Association assignments by the top executives and by the rank and file of technical workers and operators is quite exceptional. Consequently the personal relations between working members of the Association are exceptionally closeknit and harmonious. Finally, through the wise planning of its officers, the Association has created a headquarters staff and technical secretariat of exceptionally diversified experience and versatility. These are assets of incalculable value.

Recently these natural assets have been further implemented by changes designed to streamline the relationships of the committees primarily responsible for Association research. In the case of gas production research these changes began with the P.A.R. Committee and ended with the Project Supervising Committees.

The Gas Production Research Committee is the key policy and administrative body for this phase of our research work. This committee first receives any new proposal from whatsoever source. It may act directly or it may refer the project to the Technical Advisory Committee for preliminary study and report. The project then goes to the Research Planning Committee which is responsible for the division of the Association's research funds between the four major research committees. The project goes next to the P.A.R. Committee, which is responsible for the over-all allocations of the total available funds between promotion, advertising, and research.

If these hurdles as to money are safely passed, the project then comes back to the Gas Production Research Committee for administration. The latter thus assumes the principal roles of business management on behalf of the Association in respect to all the projects which it sponsors. Its personnel should therefore include those in a position to decisively influence the production policies of their companies and of their industry as a whole.

This committee depends for technical assistance, however, upon the Technical Advisory Committee, which in turn is recruited from the best technical brains of the industry. In the administration of a new project, these two committees now co-operate by setting up a Supervising Committee charged with immediate responsibility for overseeing the project. The latter directly contacts and advises the research workers to whom the project is assigned. It is its duty, acting through the Technical Advisory Committee, to keep the Gas Production Research Committee informed of its opinions and findings as the work progresses.

Considering the difficult period in which these committees were established with war shortages of both qualified technical personnel and materials and the relatively short time in which they have been operating, the variety and balance already obtained in the Gas Production Research programme is no small achievement.

The question of making an effective liaison between the Technical Section and the research committees functioning under Gas Production Research has been solved by making the chairman of the Production and Chemical Committees, ex-officio, members of the Technical Advisory Committee, and by oral reports from the chairman of the latter to these two committees.

Staff Augmented

The headquarters research advisory staff has been augmented, the research consultant and the co-ordinator of gas production research serving as secretaries to the General Research Planning, Gas Production Research, and Technical Advisory Committees. Each also sits upon the project Supervising Committees.

Organization is meaningless without the necessary motive power. But the machinery is important in controlling the release of energy. The kind of a ride which one may get for a gallon of petrol gas depends upon the design of the machine. In building better machines for industrial research we have much to learn from the industries which first built them.

The question may be asked why the building of such research machinery should concern the rank and file of the gas industry. The answer is that since association research must function by democratic processes of co-operation between its members and through its research committees, a widely diffused knowledge of how these modern research tools have been developed by sister industries, and how they should function are even more important to us than the great centrally controlled industrial companies. We, more than others, need a common language and a unifying philosophy.

Pure research might be conducted with a magnifying glass. Applied research might require an electron microscope, or *vice versa*. The complexity of simplicity of the research tools has nothing whatever to do with the case. There are two legitimate motives—curiosity and utility.

TABLE 1.—GAS PRODUCTION RESEARCH PROJECTS

PROCESS ENGINEERING RESEARCH	
Study of Hydrocarbon Reforming	I.G.T. & Phila. Elect. Co.
Sulphur Resistant Catalysts	Institute of Gas Technology
Hall High B.Th.U. Oil Gas Process	Consol. G.E.L. & P. Co. of Balt.
Fluidization Study	Institute of Gas Technology
Coal Gasification	Institute of Gas Technology
PRODUCT & ANALYTICAL RESEARCH	
Enriching Value of Oils for Carburetting	Institute of Gas Technology
Tar Investigation	Pennsylvania State College
Gas Analysis Investigation	Bureau of Standards
Mixed Gas Research	A. G. A. Testing Laboratories
Organic Sulphur Research	Institute of Gas Technology
FUNDAMENTAL RESEARCH	
Reactions Between Oxygen-Steam & Carbon	Institute of Gas Technology
Water Gas Reactions	Institute of Gas Technology

Research is pure if motivated solely by the curiosity of the investigator about the thing investigated. Its primary objective is knowledge or information. Engineering research, on the other hand, is motivated only by reasons of practical utility. The engineering researcher must know his objective. He attempts to assess its prospective values in

terms of the prospective costs of realization. If the balance-sheet looks unfavourable there is no project.

Such book-keeping is not possible in the case of pure research. The avowed purpose is not to reach a clearly defined objective but to find out what lies beyond a visible horizon. Setting values upon what one does not know is futile. The only measure of success is whether something new has been learned. It is, of course, not improper to take cognizance of the fact that pure research sometimes pays dividends in the field of engineering research.

Also in engineering research the possibility of extra dividends in the way of new information need not be ignored. But objective planning and proper cost accounting demands that these hypothetical extras should not be used as smoke-screens to becloud consideration of the primary objectives. It is mere double talk to defend a purely utilitarian project on the ground that if continued some new and unexpected information might possibly come out of it. It is equally shortsighted and sometimes painfully disillusioning to embark upon an undertaking in pure research with the firm expectation that it will pay its own bills.

Industry cannot live on the bread of engineering research alone. Frequently engineering research, left to its own devices, has a way of winding up in deadened streets. What then sometimes saves the engineering researcher from beating his head blindly against stone walls is the research of pure curiosity.

An illustration is the notable cat's whiskers and crystal period of radio detectors in the 1920's. Applied research was then endlessly searching for processes and materials wherewith to make better crystals and more sensitive cat's whiskers. The going was very hard. Suddenly the engineering possibilities of modern radio tube detection appeared as out of the blue sky—the result of pure research in other fields, an example of which was Langmuir's curiosity about the emissivity phenomena of filaments heated in high vacua.

Notwithstanding all this, Whitney, of General Electric, was the first to admit that the ratio of pure to applied research, in most industrial organizations, must be very small. One good reason, said Whitney, was the shortage of the kind of "unhampered inquiring minds" essential to the research of curiosity. Not only are there not enough such minds to go around, but it is not easy for business managements to leave unhampered such inquiring minds as they may have the good fortune to possess.

Supplies Calories

Another reason is that engineering research is the bread and butter which supplies the calories that make the wheels go around, while pure research in small doses supplies the less obvious vitamin deficiences.

Nevertheless one of the first problems of a business management desirous of conducting research is to find some way of obtaining its minimum requirements of disciplined and imaginative curiosity. Wherever a project originates, its implementation is impossible without the enlistment of qualified research workers. To ensure the continuity and stability of effort which will attract such workers requires that the rates of expenditure on pure research be within limits which the company or industry can afford to sustain through good times and bad. In practical industrial practice the ratio is usually less than 5% of the total research budget.

The additional responsibilities of management in respect to pure research are extremely important but very limited. Management should have the determining voice with respect to choice of the fields of activity or the points of departure. This it does, not by mandate, but by the selection of its researchers.

When it comes, however, to the assessment of results, evaluation of technical performance, and judgments upon the scientific values of the information obtained, business management must place its primary reliance upon its technical advisers. If these be inadequate or lack the confidence of management the only alternative is to find new advisers or to get out of fundamental research.

Engineering Research

Matters are quite different in regard to the engineering research projects which normally comprise more than 95% of the research budget. Here the shoe is on the other foot. Informed business judgment is paramount. The decisions to be made on major research projects differ in no essential detail from executive appraisals of other intangible business risks. Management goes to the experts to get the essential facts, be they technical or otherwise. Its judgments on the basis of those facts are subject to continual review to meet changing conditions, to exploit successes and to minimize losses. Thus the successful conduct of engineering research depends as much upon the calibre and soundness of executive decisions as upon the technical competence and skills of the research personnel.

Thus far we have dealt with generalizations regarding modern industrial research and their applications to the conduct of association research programmes. A detailed discussion of the individual projects of Gas Production Research would be impossible. A few weeks ago in Chicago the Technical Advisory and Supervising Committees sat for two days without covering all the projects in detail.

Table 1, however, gives a bird's eye view of what is now under way. The projects have been grouped in accordance with their general classifications, rather than in chronological order. It may be noted that the first two classifications—namely, process engineering research and analytical research, belong to the general category of applied research and that the last two of the 12 projects listed come under the category of fundamental research. The relatively high ratio of pure research to engineering research is a normal characteristic of new research programmes. As further engineering aspects are developed they will tend to absorb increasing amounts of the total research budget, but never to the complete exclusion of the research of curiosity. We have learned from long industrial experience that the higher the levels of executive contacts between the management and research groups have been, the more successful has been the engineering research.

In the early stages of industrial research the promotional and advertising values, which have been exploited so successfully by the electrical industry, for example, were sufficiently persuasive to cause some industrialists to underwrite it for those reasons alone. But it was not until such programmes matured and began to strike pay dirt that industrial research became the normal rather than the exception, and that industry learned the lesson that getting the most from industry research dollars was a job for the best research brains.

The A.G.A. has now set up the enabling machinery for such participation in its General Research Planning and Gas Production Research Committees. No member company which neglects to provide adequate representation when opportunity is afforded is entitled to complain of the decisions reached by others.

We have learned that business and research executives have come to understand each other's problems and to respect each other's functions only by living and working together. We have learned that successful engineering research is quite as dependent upon good business judgment as upon technical ability. As for fundamental research, the only job of management is to see that its research staff contains a leaven of scientific imagination and has a little elbow room in which to use it.

For better or for worse, the research of to-day holds in its hands the keys to our future. There can be no greater concern than this to the executives to whom that future is entrusted.

Member utilities may not be competitive with one another, but the gas industry as a whole must meet a highly competitive situation. Even if this were not so, our charters to serve the public interest require us to serve to the best of our ability the future as well as the present interest of the consumer. It will be too late if our competitors succeed in doing the job first.

GOVERNMENT AND INDUSTRY

The organisation and work of national consultative bodies and the co-operation between the Government and both sides of industry are surveyed and explained in *Government and Industry*, a directory for industry in booklet form, published by H.M. Stationery Office, price 9d. net. It has been prepared by the Central Office of Information. The booklet, which is in two sections, first lists and explains the functions of bodies which are concerned with national economic planning problems such as the Economic Planning Board and the National Production Advisory Council. It then deals with organizations, such as the Fuel Efficiency Committee and the Iron and Steel Board, concerned either with problems common to all industries or with those of particular industries. In all cases an address is given to which enquiries may be addressed, together with addresses and telephone numbers of regional offices.

GAS AND THE RATES

Return of Rates, 1948-49, is a new form, issued by the Institute of Municipal Treasurers and Accountants of what used to be the Preston Rate Return and the Chesterfield Return of Rates levied per head of population. In its new form the Return contains, first, particulars of rates levied and, in a separate section, particulars of rates levied per head of population. The figures cover all county boroughs (83) and metropolitan boroughs (28) and a large representative selection of non-county boroughs (209) and urban districts (184).

To the gas industry, the section of greatest interest will be that showing transfers between trading undertakings (including gas and electricity) and the rates fund. This shows that in the majority of cases the ratepayers benefit when their local authority is in business as a gas undertaking. Only in about a dozen recorded instances has it been necessary to make a transfer from the rates fund to make up a trading loss. It is possible that the reluctance of gas undertakings to increase their charges is responsible for some of the losses made and that the tendency to raise prices which has just appeared may offset some of them, though nationalization may disguise this fact.

The return also contains valuable and comprehensive information regarding population, acreage, estimated rateable value, and the cost and profits of services and local government trading undertakings.

THE BINDING ACTION OF ROAD TAR

Reference was made in the "Journal" of Aug. 18 to a Research Bulletin of the Road Tar Research Committee on the use of tar as a binder in surfacings and dressings. This Bulletin of the Committee is the latest of a series summarizing the results of researches on road tar and their application to road construction and maintenance. These researches are undertaken for the most part by the Road Research Laboratory of the D.S.I.R. in co-operation with the British Road Tar Association. The Ministry of Transport collaborates in the work.

ROAD Tar Bulletin No. 4, of which the following is an abstract, deals with the adhesion of tar to the aggregate. From the work done to date it has been possible to draw conclusions of practical value, particularly in relation to applying surface dressing in unfavourable weather, where promising methods of counteracting the effect of rain are being developed.

The binding action of a road tar depends on its viscosity and its adhesion. In so far as the mineral particles, which constitute over 90 % of the road, are made resistant to the displacing and disintegrating action of traffic and weather by the use of a viscous binder, the construction or maintenance of a tar road is primarily a problem of adhesion. It is therefore necessary to develop tars having the requisite viscosities and adhesive properties.

Asphaltic bitumen and tar binders adhere well to stones normally used as road aggregates, provided the latter are dry and not unduly dusty. Water, however, has a greater affinity for stone surfaces than has either tar or bitumen, and when a coated stone comes into contact with water there is a tendency for the binder to be displaced from the surface of the stone. The degree to which the binder will adhere to the stone in the presence of water is determined partly by the properties of the stone and partly by those of the binder.

Significance of Adhesion in Road Construction

In discussing adhesion in relation to tar roads, it will be helpful to consider the general characteristics of adhesives, an adhesive being considered as any liquid that wets a surface and is afterwards converted into a tenacious mass by cooling, evaporation, oxidation, or some other process.

The strength of an adhesive joint depends partly on the nature of the adhesive and partly on the geometric shape of the joint. It is affected by the strength of the adhesive and also by other mechanical properties of the adhesive. For example, deformability, ductility, freedom from brittleness, elasticity, and flexibility, especially under rapidly applied loads, are important properties which enable an adhesive to adapt itself to changes in volume or shape consequent on setting, ageing, and temperature changes, and assist it in withstanding impact forces. Further, an adhesive joint may be weak because the adhesive film cannot dry between non-porous surfaces. Other factors affecting the choice of the most suitable adhesive for a particular purpose are resistance to water, time of set, length of useful life to be expected, and cost.

The use of the term "wetting" as distinct from "adhesion" requires some amplification. A liquid is said to "wet" a solid when the forces of attraction between the molecules of the liquid and of the solid are greater than the force of attraction of the molecules of the liquid for each other. When such a liquid and solid are brought together, intimate physical contact ("wetting") results. In such a fashion is tar able to "wet" stone. Whether or not the liquid will act as an adhesive depends on other properties of the liquid enumerated above.

With two immiscible liquids which will both "wet" a solid, the attraction between one liquid and the solid may be greater than that between the other liquid and the solid, and preferential "wetting" will result. This is the case in the system tar-water-stone in which both liquids wet the stone. Of the two, only the tar will act as an adhesive, owing to its viscosity and other characteristics. Due regard must be paid to be above fundamental requirements if successful results are to be obtained in surface dressing or in the manufacture of tarmacadam.

The Initial Set

After the stone has been "wetted" by tar, the initial set of a surface dressing or tarmacadam is produced by the immediate increase in viscosity of the tar consequent upon its cooling, or, when an emulsion is used, upon its breaking. The subsequent loss of volatile constituents causes a further increase in viscosity and a corresponding strengthening of the adhesive bonds. Evaporation may be delayed in the case of certain types of tar, particularly those made with high-boiling flux oils. With these tars the set is largely dependent on the choice of a sufficiently high initial viscosity. In surface dressing, an important factor is resistance to displacement by water of tar from the partially coated stone, as the top surface of the stone is uncoated, and conditions favour ingress of water. Good adhesion in road construction is dependent largely on good geometric conditions at the "joint"; in surface dressing this involves the use of cubical chippings of uniform size, spread to give shoulder-to-shoulder cover.

In tarmacadam, the durability of the surfacing is affected by the content and durability of the binder itself, the relative proportioning of the fine and coarse aggregates, and the degree of interlocking of the stone structure in the consolidated mass.

When water is present the nature of the tar and of the stone both affect the strength of the adhesive bond. Low-aromatic tars give a better initial bond than do high-aromatic tars, and stones with low silica content give a better initial bond than stones with high silica content.

Tars or pitches are liquids which flow, however small the applied stress may be; if there is no interlocking of the stone structure a joint made with tar or pitch will therefore deform under an applied stress, the higher its viscosity the less being the rate of deformation. If the stress be increased beyond the tensile strength of the tar, the joint will break owing to fracture of the tar film. Overheating of the stone in pre-mix materials may lead to such increases in viscosity that this type of failure will result.

Liability to deformation, ductility, freedom from brittleness, and flexibility of the tar films are of particular importance in a road surfacing; the development of brittleness leads to disintegration of a surface dressing or tarmacadam. There are always movements in the surface due to temperature variations and traffic forces; if the tar hardens unduly through exposure to weather it may become brittle at low temperatures so that high stresses are developed when movements occur, and the adhesion between adjacent stones may then be easily destroyed.

Effect of Water on Adhesion between Tar and Stone

The binder in a freshly laid surface dressing or other surfacing is particularly sensitive to the displacing action of water; if rain falls before the binder has reached a sufficiently high viscosity the adhesive "joint" may be broken and disintegration may occur, possibly resulting in complete failure of the road. A surface dressing made with tar binder failed entirely over its full length within a few days of being laid. A surfacing made with an unsuitable binder failed within a few weeks of being laid. In each of these cases the failure was due to the destruction by water of the adhesive bond between the binder and the stone. In neither case was it possible to apply any remedial measures that would restore the surface to a good condition; it was necessary to remove from the road what was left of the materials and to lay a completely new surface. These cases are typical of premature failures which occur through water destroying the adhesion of the binder to the stone. Fortunately they do not often occur on modern roads.

In most processes involving the application of adhesives it is possible to ensure cleanliness and dryness of the surfaces so as to give intimate contact between the adhesive and the surfaces to be joined. In road construction, however, the stones are seldom either clean or dry. In surface dressing, for instance, the stones are frequently wet when they are applied to the binder, and rain often falls before the stone has dried sufficiently to adhere firmly to the tar.

The properties of the binder which chiefly affect adhesion in the presence of water are its chemical nature and its viscosity; those of the stone are its chemical nature, its shape, and its surface texture. The chemical nature of the materials determines the specific adhesion or the forces of attraction between the molecules of the tar and the molecules forming the stone surface. The viscosity of the tar determines how quickly these adhesion forces can produce any effect. The lower the viscosity the more quickly will the tar flow over and into the irregularities of the dry stone, and conversely the more quickly will it be displaced from the stone surface by water; the higher the viscosity the more slowly will intimate contact be made with the solid surface and also the more slowly will displacement occur when rain falls.

The surface texture of the stone affects the adhesive bond in several ways. The smoother the stone the more easily is intimate contact made by the tar and the more easily does the tar flow over the stone surface. On the other hand, when water makes contact with the coated stone it will displace the tar more easily the smoother the surface of the stone.

Measurement of Adhesion

Many different types of laboratory test have been developed to measure the resistance of the bond at the tar-solid interface to the action of water. They fall into two main classes; tests which measure some fundamental property of the system binder-stone-water, and comparative tests which measure or compare the resistance to displacement of binders by water from road stones or sand particles, which measure the reduction in strength of moulded specimens of road-surfacing mixtures after immersion in water.

It is characteristic of all liquid surfaces or interfaces that they tend o contract to the smallest possible area. This tendency is shown in the spherical form of small drops of liquid, in the tension exerted by soap films, and in many other properties of liquid surfaces. The property may be accounted for by the simplest properties of molecules in the liquid state; although the molecules of liquids are free to move relative to one another they are kept close to each other by the cohesional forces between them. In the interior of the liquid each molecule is surrounded by others on every side and is therefore subject to attraction in all directions. At the surface, however, there is no outward attraction to balance the inward pull, hence every surface molecule is subjected to a strong inward attraction perpendicular to the surface. This inward attraction causes the surface to diminish in area, because the surface molecules are continually moving inwards more rapidly than others move outwards to take their places; the number of molecules in the surface is therefore continually diminishing and the contraction of the surface continues until the maximum possible number of molecules are in the interior—that is, until the surface is the smallest possible for a given volume.

Free Surface Energy

As a result of this spantaneous contraction, work must be done to extend the surface of a liquid; the work is required to overcome the inward attractive forces when bringing molecules from the interior of the liquid into the surface. The work required to increase the surface area by one square centimetre is called the free surface energy.

Since it tends to contract, a liquid surface behaves as though it were in a state of tension, this tension being the same at every point and acting in all directions parallel to the surface. In the solution of problems relating to the equilibrium of liquid surfaces, a mathematical device is used by which this tension is substituted for the free surface energy. The tension is defined as the force (in dynes) acting at right angles to a line in the surface one centimetre long, and it is numerically equal to the free surface energy per square centimetre. It is known as the " surface tension " of the free liquid surface, or as the " interfacial tension," if tension of the interface between two immiscible liquids or between a liquid and a solid is being considered.

One method of estimating the force of displacement is to measure the interfacial tension between binder and water by means of a du Nouy tensiometer and to measure the contact angle separately. In the tensiometer, the force required to separate a wire ring from the interface is measured.

Results show in a quantitative way that the force of displacement exerted by the water is least against the low-aromatic tar and greatest against the asphaltic bitumen and petroleum and kerosene oils.

The better wetting properties of road tar are mainly due to its hydroxyl components. When all the phenolic compounds are removed from tar by washing with alkali the wetting properties are adversely affected. When asphaltic bitumen is cut back with creosote oil its wetting properties are much improved; if, however, the creosote oil is washed with alkali to remove the phenols its wetting properties are no more effective than those of kerosene. Recent work on the resistance of tars to weathering has shown that the durability of some tars is markedly improved by removing the phenolic constituents. Since improvement in durability of road tars is of primary importance it may be necessary to determine the least amount of phenolic material required to ensure good adhesion.

In the two main tests (the film test and the bottle test) a solid, either stone or glass, is coated with a binder, and then submitted to the displacing action of water.

The Drop Method

In the drop method [described in the Bulletin] equilibrium between binder and water is obtained by a movement of the binder outwards towards the water over a surface already wet with water. On the road it is more usual for the solid to be first wetted by the tar and then for displacement by water to occur subsequently. A simple method of comparing different binders under these conditions consists of spreading a film of the binder of known thickness on glass or on ground or polished stone, and immersing the coated specimen in water. The amount of stripping is recorded as a fraction or a percentage of the originally covered area exposed by the water.

Texture is one of the important factors affecting adhesion; a test is therefore necessary in which the stone is used in its natural condition without special treatment. In the simplest test of this kind the dry stone is coated with the binder and immersed in water and the amount of displacement of the binder is assessed by visual inspection. Many modifications of this test have been developed by various investigators; the temperature at which the test is carried out varies from laboratory to laboratory and may be at any value between atmospheric temperature and the boiling point of water.

At the Road Research Laboratory aggregate of a single size, either ¾ in. or ½ in., is coated with 3.5% by weight of the tar binder under test, the stone and binder being heated to the temperature appropriate to the type and viscosity of the binder being used. A sample of the coated stone is allowed to cool in an 8 oz. bottle for half an hour and then covered with distilled water; the bottle is closed and left undisturbed at 30° C. The displacement of the binder is assessed at intervals by visual inspection, the area of the stone surface exposed being expressed as a percentage of the total area of the stone. Usually little further displacement occurs after two days' immersion in distilled water.

The Riedel and Weber test is an immersion test in which sand-size aggregate (passing 0.6 mm. and retained on 0.2 mm. sieve) is coated with binder and then boiled in successively increased concentration of sodium carbonate solution. The adhesion is expressed in terms of the limiting concentration which produces stripping of the binder. Although this test has been much used it has been suggested that chemical action will occur between the sodium carbonate and certain road binders, whereas no such action will occur on the road under natural weather conditions; the test may thus differentiate falsely between certain types of binder. Further, the size of the particles is so small that the effects arising from the surface characteristics of the stone are not reproduced, although by modifying the test and using a ½ in.-⅜ in. fraction of the road stone, this difficulty has been overcome.

The R.R.L. immersion test is to be preferred since it is simple to perform and it takes account of both shape and texture of the stone; the samples after test can be stored while still immersed, making them easily available for comparison and future reference.

Tests have been described recently in which a graded aggregate mixture with bituminous binder is moulded into specimens suitable for testing mechanical strength, the specimens being tested before and after immersion in water. A bituminous mixture containing the full gradings of aggregates is made and cylinders 4 in. by 4 in. are moulded by means of a hydraulic press using a pressure of 3,000 lb./sq. in. maintained for 2 minutes. Mixtures containing the more viscous binders are moulded immediately after mixing and those of lower viscosity after 24 hours' curing at room temperature. All the specimens are then maintained at 60° C. for 24 hours and afterwards allowed to stand overnight at room temperature. They are then weighed in air and water to determine specific gravity and volume.

Three cylinders are brought to the test temperature, 25° C., and tested for compressive strength. At the same time nine cylinders are completely immersed in water at 25° C. and tested in sets of three after various periods of immersion (such as 2, 4, and 7 days). Just prior to testing, each specimen is weighed in water and air to determine absorption and volume change. The compressive strength is determined on a hydraulic testing machine using a platen speed of 0.2 in. per minute.

The mechanical stability test is more reliable than the static water immersion test because:

(*a*) The whole of the aggregate mixture is tested and not merely aggregate of a single size;
(*b*) The soundness of the aggregate is directly measured in terms of stability retained by the whole mixture;
(*c*) The results are expressed in numerical values and are not affected by the personal factor as in visiual estimation.

Results of Laboratory Investigations

Different types of stone behave very differently as regards their adhesion to bituminous binders when in contact with water. The differences are generally independent of the nature of the binder, and stones that show relatively poor adhesion with one type of binder also show poor adhesion with other types of binder.

As previously stated, the properties of the stone that affect its adhesion to tar when immersed in water are its chemical composition, its shape, and its surface texture. Moisture content at the time of coating also markedly affects adhesion. It is difficult to devise a test that will differentiate conclusively the part played by each of these factors separately. In an attempt to eliminate the effect of shape and testure, flat surfaces of various types of stone can be prepared and polished so as to give a glass-like finish. When drops of tar are introduced on to these prepared stone surfaces under water the adhesion tension can be measured, and the results indicate the tendency of the tar to be displaced by water from the various types of surface.

Results suggest that the relative adhesion of tar to stones in the presence of water is not greatly affected by the chemical composition of the stones. Other investigations are still in progress on this aspect of the subject.

General experience in bituminous road construction has indicated that certain classes of road stone generally adhere well to bituminous binders while other classes contain stones that often give poor results. For instance, with certain glassy types of flint gravel the binder is soon partially displaced from the surface of the stone; certain types of highly siliceous igneous rocks and certain quartzites are also reputed to have poor adhesive qualities, but limestones and other calcareous stones are considered generally to adhere well to bituminous binders when used in road construction. These observations have given rise to a commonly stated generalization that " acid " rocks as a class give poor adhesion and " basic " rocks give good adhesion. The terms " acid " and " basic " in this sense refer to the geological classification which depends largely upon the silica content of the rock.

Limestones and siliceous limestones have silica contants varying from zero to 90%; sandstones, quartzites, and flint gravels may contain 100% silica.

When stones covered by this classification are investigated in suffi-

cient number, however, it is found that stones with both good and poor adhesion can occur in each of the groups; stones having good adhesion occur in the " acid " groups and others having poor adhesion occur in the " basic " groups. When siliceous limestones are investigated, although the presence of silica is often associated with poor adhesion, it is found that some of these stones having high silica and low calcium carbonate contents adhere well in the presence of water.

From the available information there does not appear to be any conclusive evidence that difference in chemical or mineral composition alone will account for the relative adhesion properties of normal road stones. The differences found in practice between various types of stone must therefore be due not so much to the specific chemical relations between the stone and binder as to the physical, mechanical, and geometric properties of the stone. These properties are not easy to define precisely and general classifications only have so far been used.

Shape and Texture

The shape and texture of a stone are defined according to the following scheme:

Shape

Rounded: fully water-worn or completely shaped by attrition.

Irregular: partly shaped by attrition, with rounded edges.

Angular: possessing well defined edges formed by the intersection of roughly plane faces.

Flaky: usually angular, and having a thickness which is small relative to the width or length.

Texture

Glassy: having conchoidal fracture.

Smooth: water-worn or smooth owing to laminated or mechanical fracture.

Rough: having moderately rough mechanical fracture.

Crystalline: containing easily visible fine, medium, or coarse-grained crystalline constituents.

The simple immersion test has shown that when the stone is initially completely coated with binder, the shape of the stone is the property which determines the initial stages of displacement by water. Displacement begins sooner from stones with sharp edges than from rounded stones. As the film of binder surrounding an immersed stone tends to contract so as to reduce its surface area to a minimum, it will become very thin at the edges of the stone and will easily rupture or be penetrated by water at these places. Displacement may also begin at proud spots apart from edges. Displacement begins more readily from the flaky and angular stones than from the rounded and rregular ones. From this point of view uncrushed, rounded gravel has an advantage over broken stone.

Once displacement of the binder has begun, the subsequent rate of displacemen and the final amount of displacement will be influenced by the surface texture of the stone. With angular stones displacement occurs more readily where the surface texture is crystalline than where it is mechanically rough. This is to be expected since the coarse-textured surface presents numerous small edges to the binder film which produce thinning for the same reason as do the edges of the stones themselves but on a smaller scale. Furthermore the binder will be displaced with relative ease from the smooth facets of the coarsely crystalline rock once it has begun to move at an edge. Displacement will also occur readily from the glassy or smooth surfaces of gravels. If the surface of the stone is porous, and if the stone has been adequately dried before coating, the binder will enter the pores, thus making displacement by water difficult.

If the stone is already in contact with water the binder wets a rough stone surface less than it wets a smooth surface. If, however, the dry surface is coated with tar and then immersed in water, the water will produce displacement of the tar more readily from the smooth surface than from the rough surface.

Change in Surface Energy

This effect of texture is connected with the change in surface energy which occurs when the tar film retracts from the stone and the stone-binder interface is replaced in part by a stone-water interface. The displacement of the binder involves a change in surface energy which is equal to the difference between the interfacial energy of the stone-binder interface and that of the stone-water interface. This change in energy is proportional to the true surface of the stone from which the binder is displaced, and since the actual area per unit of geometric surface is greater for a rough-textured stone than for a smooth-textured one, less apparent shrinkage of the binder film will be required to expose a given surface of a rough-textured stone than of a smooth-textured one.

In general, therefore, the stones which adhere best to a binder in the presence of water are those having a rather finely roughened texture.

Stones with good adhesion and others with poor adhesion are found to occur in each of the different trade groups, and in general, shape and surface texture define their quality in this respect.

One purpose of incorporating filler in a tarmacadam is to increase the viscosity of the binder after it has coated the stone. The higher viscosity so produced will enable the tar to resist the displacing force of water more effectively.

If the filler used gives an alkaline reaction, however, added resistance to stripping is imparted, particularly if the binder is tar or creosote cut-back bitumen containing appreciable proportions of phenolic constituents. For example, when stone was coated with binder to which was added in one case limestone filler and in another case hydrated lime, both mixtures gave greater resistance to displacement than the tar alone, but the hydrated lime gave a better result than the limestone filler.

Surface dressing is a simple application of adhesion, and the conditions that are necessary for all adhesive joints apply particularly to surface dressing. The viscosities of tar required to enable the tar to wet the road and the stone at various times of the year have been found by experiment and experience. The more fluid tars are employed in the cooler months and the more viscous tars in the warm months. Since, for best adhesion, the tar film must rise up the sides of the chippings so that each chipping is held to its neighbours as well as to the road surface, the quantity of tar must depend on the size of chipping used. This quantity must also depend on the shape of the chippings, rounded gravel clearly requiring more than angular or cubical stones. The drying properties or volatility of the tar are important because they affect the increase in viscosity required in the early life of the dressing. These aspects have been considered in more detail in previous Bulletins (Road Tar Bulletins Nos. 1 and 2).

Lack of Initial Adhesion

One of the most important problems from the adhesion point of view is that arising from lack of initial adhesion owing to the presence of water. The higher viscosities recommended for modern surface dressing reduce the risk of displacement of tar by water and such displacement is now rare; moreover, the high viscosity of the tar almost invariably prevents any significant movement being caused either by traffic or by water.

When wet stone is used for surface dressing a film of water is trapped between each stone and the tar, and the stone can be picked off without any tar adhering to it. Fast traffic travelling over the dressing when it is in this condition may throw off the stone to the road-side. When, however, the stone is spread as a layer over the tar film the climatic conditions during the surface-dressing season will generally cause it to dry quickly; the trapped water soon disappears and the stone, usually adheres to the tar after a few minutes. It is for this reason that traffic should not be allowed on the newly laid dressing until the stone has been wetted by the tar. Certain chemicals, if applied to the wet stone, reduce the interfacial tension between the tar and water and enable the water film to be pushed aside, so permitting wet stone to adhere to the tar immediately it is spread. Cationic detergents such as cetyl pyridinium bromide dissolved in creosote oil are particularly effective in this respect. When a wet aggregate is mixed with as little as 0.1% of such a solution, the water film is removed from the stone surface, and its place is taken by the creosote solution, enabling the stone to adhere immediately to sprayed tar, and thus preventing the ultimate displacement of stone by traffic. This process has only recently been developed, and some details require further experiment, particularly with regard to developing simple methods of applying the active solution to the stone. However, the process has already been tested on full scale experimental surfaces and shows considerable promise.

If the tar is sprayed on to a wet road, water is trapped beneath the tar film and initially there is no adhesion to the road. The incorporation of adhesion agents in the tar does not overcome this difficulty. As pointed out when discussing the lime process for the coating of wet aggregates the best effect is obtained when the wet stone is treated with the chemical agent. If, however, care is taken in surface dressing to ensure that the stone adheres to the tar, the immediate adhesion of the tar to the road is apparently of only secondary importance. The water trapped beneath the tar film slowly disperses after some days and the tar then adheres to the road.

Adhesion in Tarmacadam

The function of tar in tarmacadam is to bind the aggregate together so that it will resist the displacing forces due to traffic. Modern specifications such as those given in B.S. 802, B.S. 1241, and B.S. 1242 (Tarmacadam) and Wartime Road Note No. 7 (Tar Carpets) are drawn up with particular regard to temperatures of mixing, quantity and viscosity of tar and filler content, to prevent early embrittlement of the tar by overheating and to prevent draining away of the tar. The later embrittlement of tar due to volatization and oxidation is the subject of another research to be reported later.

The adhesive properties of tar are generally good in regard to the resistance of the tar to displacement from stone by water, so that tarmacadam made to modern specifications such as those mentioned above seldom suffers from displacement by water, and in general, with premixed materials, adhesion failures are not likely to occur with tar binders. However, there are a few stones of extremely poor affinity, such as certain felsites and quartzites, which give poor results even with tar binders, and in such cases the displacing action of water can be reduced or eliminated by incorporating in the tar a suitable adhesion agent. For example, 2% of a heavy-metal soap such as iron oleate when added to tar will generally prevent water displacement. The cationic detergent cetyl pyridinium bromide is also effective in

quite small quantities, even ¼% dissolved in tar being sufficient for most purposes.

The presence of undue amounts of dust on the surface of crushed stone sometimes makes it difficult to coat the stone with binder, particularly when the stone is slightly damp. In such cases, "priming" the stone with a low-viscosity oil (creosote oil) facilitates coating of the stone when the binder is added. To give the binder finally present in the mixture a sufficiently high viscosity, the tar used in conjunction with the priming oil should be of a higher viscosity than that normally used. The adoption of such a priming technique is also useful with stone having poor water-resistance, mixtures made using priming oils having greater water-resistance than corresponding mixtures made in the normal way.

It has been known for a considerable time that the use of hydrated lime as a filler in bituminous road mixtures improves the adhesion of the binder to the stone. If, however, the lime is mixed with stone before the addition of the tar binder, an even greater effect is produced and it becomes possible to coat stone which is saturated with water. Its success depends on the adhesion tension being reduced to a very small value when the water surrounding a drop of tar is made alkaline by the solution of the lime. When wet stone is mixed with lime and tar there is possibly formation of calcium phenates which may induce emulsification of water into the tar, and this effect, together with the lowering of the value of the adhesion tension, makes possible the complete coating of a wet stone. This phenomenon has opened up an entirely new process in the manufacture of tarmacadam, and investigations are in progress to ascertain how road surfacings made with wet aggregate and hydrated lime compare in regard to durability with those made by the conventional process of drying and heating the aggregate.

ENGINEER ADMINISTRATORS

The following is an abstract from an article by D. B. Hoseason, M.I.Mech.E., M.I.E.E., in the July issue of the *Journal* of the Engineers' Guild. The author is a member of the Guild's General Council.

In many industries and public services, the administration is in the hands of men who have been educated strictly with a view to administration. The technical experts and scientists are kept free of administrative responsibility, their particular contribution being restricted to technical fields. This condition of affairs does not hold in the engineering world, although from time to time isolated examples appear in which the field of the engineer is restricted to engineering subjects. In general the most successful engineering companies and organizations are those in which the higher management has a preponderance of fully qualified engineers. The successful engineer occupies his day more and more with administrative matters as he rises in the profession, until when he is appointed a sales manager he is probably far more concerned with administration and matters connected with the functional work of selling than he is with the technical characteristics of the product being handled. As a sales director he is even less concerned with technical matters and mostly occupied in higher administration, and at managing director level his work is almost entirely administration.

Is there any justification for engineer administrators? Would the nation be better off if all engineers kept strictly to the technical field and left administration in the hands of those educated specially for the duties?

Administration involves leadership. The qualities which make for successful leadership are not peculiar to any one section of society. Even with the existing British social developments in the educational world they are not yet peculiar to any one educational level. At the university level, the classical scholars have produced neither more nor fewer leaders than the science graduates, and present-day industry in fact shows far more leaders from the part-time educational field than any other. The great shortage in industry and the public services is for leaders or administrators, and if the ranks of those trained technically as engineers have their own quota of inherent leaders, then the nation should tap this source, and for this, if no other reason, we are justified in having engineer administrators. It is surely advantageous that those controlling groups of engineers should know something of engineering matters, so long as the profession can throw up its own quota of leaders.

There is, however, a further reason for the appointment of engineer administrators. Engineering is applied science—that is, science applied for the service of mankind—and every branch of our profession has its origin in scientific activity in some laboratory. The practical application of this scientific knowledge involves the development of equipment and appliances usually very different in form from the standards permissible in the laboratory. The manufacture of this commercial equipment is limited by the skill of the various classes of workmen and by the equipment available in the factory, and the border line between what is practicable and what cannot be done is far from precise. In fact, it is frequently practicable to manufacture a particular design of equipment while it is nevertheless not economical to do so as the finished product has such a standard of complication that it cannot be produced at an economical price. One of the difficulties of the situation is that in the initial stages of a production programme of engineering equipment it is frequently a matter of judgment, rather than being directly calculable, whether or not the particular design of product is a commercial proposition. The decisions must be taken by a responsible administrator and only an adequate engineering background will give the standard of judgment needed.

Training in Administration for Engineers

Many engineers take on administrative responsibilities so gradually that the change in their activity is not always realized and they fail to equip themselves for their new responsibilities to the extent that they might do. There is no doubt but that administration calls for a broad liberal education and the concentrated work which the young engineer has to do in the scientific field frequently prevents him from giving the attention to philosophy and the arts which full administrative success usually needs.

The young engineer, therefore, of 28 or 30, who finds himself becoming an administrator, should take steps at self-education which, in the main, should widen his knowledge in the classical and arts spheres. There are certain fundamentals on which the whole structure of administration is built and these are usually to be found in the great essays, not only in Greek literature but in those of the present day. Apart from the examination of what have been called "the fundamentals of administration," the younger manager should make a practice of reading literature which deals with the application of these fundamentals.

Probably the least important section of administrative knowledge, but one which cannot be ignored under modern conditions, is that which deals with the tools of administration such as mechanical costing, labour cost control, and aids to productive efficiency, aptitude testing in the formation of a team, market research in the development of sales, and so on. Books on these subjects are legion, but considerable discrimination is needed in the selection of authors who can be relied on to present their subjects without exaggerated importance placing each technique in its proper relation to the general field of administration.

The young administrator also has a responsibility to his job in connexion with the routines involved. Some examples of these are public speaking, report drafting, and the taking of the chair at a meeting. Chairmanship of gatherings is an important part of the administrator's equipment, and very few men are sufficiently gifted to be able to rely on their natural aptitude, without taking regular training in this field. Words are the principal tool of the administrator and a power over words is essential to handling a team effectively.

In general, the young engineer with an aptitude for leadership has all the necessary fundamental qualities for a successful career as an engineer administrator. He must, however, realize that his early success as an engineer probably owes much to the concentrated attention he has given to engineering matters and has resulted in a corresponding lack of knowledge on administrative subjects. Although some self-congratulation is justified on a man's first appointment to a senior position, this must very quickly be followed by a genuine humbleness of outlook towards the responsibilities with which he is faced. On the whole, the engineering industry is well managed. Our experience, however, as engineers, tells us that there is nothing that cannot be improved.

INDUSTRIAL GAS IN THE WEST MIDLANDS

A constantly increasing demand for Mond gas throughout South Staffordshire is necessitating further extensions to the manufacturing plant at the works of the South Staffordshire Mond Gas Company, Dudley Port, Tipton, of which the active Chairman is Mr. W. Edgar Hale. The Company supplies many of the largest engineering firms with the bulk or all of their requirements of gaseous fuel for a multiplicity of heat treatment processes. The area of supply, which covers 120 sq. miles, includes Wolverhampton, Walsall, Willenhall, Wednesbury, Darlaston, Bilston, and Tipton.

The present daily output of gas exceeds 30 mill. cu.ft., but the Ministry of Fuel and Power have now sanctioned the erection of additional plant which will enable the Company to supply another 6 mill. cu.ft. per day. Work on this new unit will start next year. In order to deal with the greater by-product yield, a new tar distillation plant is being installed which, together with the existing plant, will enable a daily throughput of 35 tons of tar to be maintained. The stills will be of the continuous type and fabricated from stainless steel, the whole installation being the work of Clayton, Son & Co., Ltd., of Leeds.

Other extensions now almost completed include a water tube boiler plant installed by Babcock & Wilcox, Ltd. This boiler, which is fired by coke dust, is entirely automatic, and provides sufficient superheated steam for the generation of all the electric current required by the works, the whole of the turbine pass-out steam being then de-superheated and fed to the low-pressure process mains. This plant will effect a raw coal saving of over 20,000 tons per year, and in addition will remove an appreciable load from the electric grid.

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COMPANY NEWS

Nico Light Engineering Co., Ltd.

The accounts for the year ended Mar. 31 show a profit of £11,994. After bringing in £7,182 from the previous year and transferring £7,201 to reserve, a dividend of 10% and a bonus of 5%, making 15%, less tax, leaves £7,510 to be carried forward. Mr. R. E. Green, Chairman, in his statement circulated with the report and accounts, states that sales showed a very satisfactory increase, despite many difficulties and particularly serious power cuts which slowed up production, despite the fact that a third of the factory was working on night shifts. To avoid as much interference as possible during the present financial year diesel electric generating plant to cover the load o at least half the factory and eliminate the necessity for night work has been installed. The plant is now in operation and in view of Sir Stafford Cripps's recent warning that the cuts may be even greater than last winter the Directors feel they have taken the right course in the Company's interest. During the year important additions to the plant and machinery and extensions to the factory have enabled the Company to manufacture a number of new lines for which it was not previously properly equipped.

United Gas Industries, Ltd.

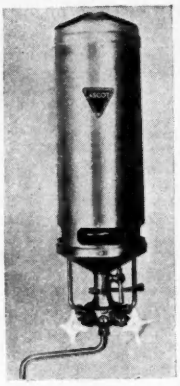
The accounts for the year ended Mar.31 show a profit of £546,037, an increase of £149,266 over the total for the previous year. There is added a sum of £21,083 for credits relating to previous years, against £22,523, and interest totalling £2,621, against £3,429, making a total of £569,741, compared with £422,723 for the previous year. Aggregate net profit of £192,984, against £152,560, was arrived at after deduction of directors' fees, £5,000 (same), and other emoluments, £22,400, against £22,150, depreciation, £49,565, against £60,959, stock reserve, £25,000, against nil, group pension scheme, £7,699, against nil, audit fees, £1,050 (same), and taxation, £266,043, against £181,004 Profits retained by subsidiaries totalled £28,345, compared with £13,176, leaving the net profit of the parent company £164,639, against £139,384. Ordinary dividend for the year is repeated at 17% (interim 5% and final 12%), absorbing £63,799, and that on the Deferred is again 1s. 9d. per share, taking £26,273. General reserve allocation is doubled at £50,000. The carry-forward of the parent company is raised by £3,423 to £32,544 and that of the subsidiaries by £28,345 to £376,768.

NEW COMPANY REGISTRATIONS

During the half-year January to June, 1948, three new chemical companies were registered at Bush House, London, two new companies under the general heading of electricity (radio), gas and water, five new engineering companies, and one mining company. These figures are given in the list of *New Company Registrations* issued by Jordan & Sons, Ltd., Company Registration Agents, 116, Chancery Lane, London. During the same six months a total of 9,827 new companies were registered, a reduction of 13% on the same period of 1947. The average capital was £5,571.

Industrial Water Heaters

Two new industrial water heating appliances have been introduced by Ascot Gas Water Heaters, Ltd. One is a sink heater (illustrated here) and the other a boiling water heater. These appliances are in industrial finish and are not for domestic purposes. No purchase tax is payable on either model. The type numbers respectively are IR12 and IRS52, and the shell of aluminium is finished in silver grey and the brass fittings are lacquered. The appliances, it should be emphasized, are suitable for installation only in "industrial" premises such as factories, shops of all kinds, stores, hospitals, schools, public houses, restaurants, canteens, and kindred establishments excluding professional and commercial offices. A substantial saving is shown to the consumer, and these appliances are already being installed throughout the country.



GAS STOCKS AND SHARES

It has been a cautious week on the Stock Exchange, due largely to the absence of the promised interim communique on the progress of the Kremlin talks, but the tone generally was firm. "Markings" reached 31,281 for the week, compared with 28,073 and 25,007 in the previous two weeks, and were at their highest level for a Monday since July 19 on Aug. 30, at 6,746. Both the British Funds and industrial securities gained, the former steadily from 112.75 to 112.93, the latter more easily from 115.13 to 116.6. Gas dealings, at their highest for the week on Aug. 30 with 53 deals, totalled 221: the previous week's figure was 207.

Among principal price changes on Sept. 2 were De La Rue, up 1s. 3d. to 40s., and I.C. Gas, up 2½ to 114.

During the week it was announced that a Court of Inquiry into engineering wages had recommended a 5s. a week increase in the national bonus.

The week's price changes in gas undertakings were as follows:

OFFICIAL LIST

Barnet, ord. 7 p.c max.	154	—159	+ 1
Imperial Continental, cap. ...	100	—115	+ 3
M.S. Utility 'B' cons.	70	— 75	+ 2
South Metropolitan, 5 p.c. red. deb.	98	—103	+ 1
U. Kingdom, Ltd. ord.	23/	— 24/	+ 3d.

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